Eleanor Reid

Ninety-Sixth Meeting of The Electrochemical Society, Inc.

CHICAGO

October 12, 13, 14, and 15, 1949

LOCAL COMMITTEE

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Armour Research Foundation
Chicago, Illinois

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Entertainment

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Ladies' Program

MRS. C. A. HAMPEL

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CLYDE A. CROWLEY
L. G. VANDE BOGART
O. W. STOREY

Ninety-Sixth Meeting

Wednesday through Saturday
October 12, 13, 14, and 15, 1949

GENERAL INFORMATION

Convention Headquarters will be at the **La Salle Hotel,** Madison Street at La Salle Street. The registration desk will be in the elevator foyer of the mezzanine on Wednesday evening and in the elevator foyer of the 19th floor for the balance of the meeting. All technical meetings will be held on the 18th and 19th floors. The luncheons and Convention dinner will be served in the Grand Ballroom on the 19th floor.

Rates for rooms (all with bath) will be: single, $5.00 to $8.00; double with double bed, $7.00 to $10.00; double with twin beds, $9.50 to $12.00; two rooms with connecting bath, $9.50 to $15.00; parlor, bedroom, and bath, $9.50 to $25.00; special suites, $26.50 to $35.00.

Requests for room reservations should be made preferably on the special reservation cards sent to the members; otherwise such requests should be made directly to the Hotel La Salle with mention of The Electrochemical Society affiliation.

All times given are Central Standard Time.

REGISTRATION

Registration of members and guests will begin at 7:00 P.M. on Wednesday, October 12th. The registration desk will be open daily from 8:00 A.M. to 5:00 P.M. throughout Thursday and Friday, and from 8:00 A.M. until 12 noon on Saturday.

The registration fees through Wednesday, Thursday, or Friday are:

Members	$6.00	Ladies	$2.00
Non-members	$8.00	Students	$1.00

On Saturday the fee will be $1.00 for all who register.

Advance registrations are urged. They should be sent with check made out to Ben F. Freeberg and mailed to him at 8801 South Ada Street, Chicago 20, Illinois.

LOUNGES

In addition to the men's and women's lounges off of the elevator foyer on the 19th floor, a lounge with refreshment service is to be main-

tained in Rooms 1840-2 adjacent the Press Gallery on the 18th floor. A loud speaker in the lounge will be connected to the speaker's table in the Century Room on the 19th floor. The chairmen of the technical sessions held in this room will be asked to announce the titles of papers as they are about to be presented.

LUNCHEONS AND DINNER

Thursday Luncheon

This will be held in the Ballroom at 12:30 P.M. Dr. Otto Eisenschiml, one of Chicago's best-known chemists and authors, will be the luncheon speaker. He will "spin a yarn," half literary and half historical, concerning one of his experiences.

Thursday Evening Social Hour
Dinner and Entertainment

A Social Hour in the Century Room, 19th floor, commencing at 6:15 P.M. will precede a special steak Convention dinner in the Ballroom at 7:15 P.M. A program of varied entertainment, including a floor show, with Ben Sharp as Master of Ceremonies, will follow, after which Ben Sharp and his orchestra will provide the music for dancing. **Refreshment** facilities will be conveniently available.

Friday Luncheon
Joseph W. Richards Memorial Lecture

This luncheon will be served in the Ballroom at 11:45 A.M., following which the Joseph W. Richards Memorial lecture will be given.

Friday Evening

A Convention dinner is not scheduled for Friday evening so that the members may feel free to go to their favorite Chicago eating-place. However, the Local Committee is providing Section "Q" facilities after 7:30 P.M. in the Press Gallery and adjoining rooms 1840-2. There will be an Open House until after midnight. Here the members and guests may visit with old and new friends, partake of food snacks furnished by the Committee, play cards, and otherwise rejuvenate long dormant "Q." Refreshments will also be available. Come and go at will.

Saturday Luncheon

The **Electrodeposition Division luncheon** will be held in the Ballroom at 12:30 P.M. Past-President Frank C. Mathers is to be the Honor Guest and will talk on the effect of unusual things in electroplating and refining. Dr. Allen

G. Gray will tell about the forthcoming revised edition of "Modern Electroplating." Members of the American Electroplaters' Society of the Chicago area have been invited to attend the sessions on electroplating and the luncheon.

LADIES' PROGRAM

The full program for the ladies consists of:

Thursday: Kaffee-Klatsch (Milwaukee-style coffee) and get-together starting at 10:00 A.M. in Suite 209-210 (2nd floor). The ladies will be given detailed information at this time about the ladies' activities. This will be followed by a luncheon at Marshall Fields at 1:00 P.M.

Friday: A chartered boat trip along the lake shore in the Chicago harbor will start at the Wrigley Building Pier. Taxis will leave the La Salle Hotel for the pier at 10:30 A.M. with the boat trip scheduled for 11:00 A.M. In case of inclement weather, an equally attractive trip will be taken. The boat trip will be followed by luncheon at the widely-known Kungsholm Scandinavian Restaurant at 12:30 P.M. The Melchoir room has been reserved for the occasion and a special Smorgasbord is to be served. At 2:00 P.M. a bus will leave the Kungsholm for the world-famous Oriental Institute on the University of Chicago campus where a specially conducted tour will start at 2:30 P.M. The bus trip will be over the attractive Chicago park system boulevard along the Lake Michigan shore.

PLANT TRIPS

The progam includes three trips of special interest including one each on Thursday afternoon and on Friday morning and afternoon.

Thursday Afternoon 2:00 P.M. Hotel La Salle (Madison St.) leaving time; Armour Research Foundation.

Friday Morning 9:00 A.M. Hotel La Salle (Madison St.) leaving time; Lakeside Press of R. R. Donnelley & Sons Co., and Chicago Electrotype Foundry.

Friday Afternoon 2:00 P.M. Hotel La Salle (Madison St.) leaving time; Carnegie-Illinois Steel Corporation, South Works (electric steel operations).

Buses will be provided and will leave the hotel at the designated times. Advance registration will be needed to assure transportation facilities. Charge for each trip, $1.00.

Arrangements have also been made for special guides for those who wish to visit the Northwestern University Technological Institute at Evanston. Those who plan to go may obtain transportation information from the Plant Trip Committee.

COST OF VARIOUS FUNCTIONS
(other than registration)

Thursday Luncheon (Men)	$ 2.75
Thursday Kaffee-Klatsch (Ladies)	No Charge
Thursday Luncheon (Ladies)	2.25
Thursday Convention Dinner, social hour, dinner, and floor show	7.00
Same (for couples)	12.00
Friday Luncheon (Men)	2.75
Friday Boat Trip (Ladies)	1.25
Friday Luncheon (Ladies)	2.75
Friday Oriental Institute transportation (Ladies)	.75
Saturday Luncheon (Men)	2.75
Each Plant Trip—transportation	1.00

ANNUAL BUSINESS MEETINGS OF DIVISIONS

Battery Division—will hold its annual business meeting and election of officers at 9:00 A.M., Friday, October 14th, in the Press Gallery.

Corrosion Division—will hold its annual business meeting and election of officers at 4:40 P.M., Thursday, October 13th, in the Century Room.

Electrodeposition Division—will hold its annual business meeting and election of officers immediately following the Division Luncheon on Saturday, October 15th.

Electro-Organic Division—will hold its annual business meeting at 2:00 P.M., Friday, October 14th, in Room 1860.

ROUND TABLES

Electro-Organic Division—will sponsor a round-table discussion of industrial electro-organic processes, economic evaluation of electro-organic processes, and other technological matters. This round table will be held on Friday, October 14th, at 2:15 P.M., immediately following the Division's Business Meeting, in Room 1860.

Battery Division—will hold simultaneous round-table discussions on Friday, October 14th, at 9:15 A.M., in the Press Gallery, immediately following its Business meeting. Dr. J. N. Mrgudich will preside at a discussion of "The Structure of Manganese Dioxide" and Dr. Eugene Willihnganz will direct a discussion of "Low Temperature Performance of Storage Batteries."

COMMITTEE MEETINGS

Wednesday, October 12, 1949

1:00 P.M.—Meeting of Ways and Means Committee, Parlor F, Mezzanine.

1:00 P.M.—Meeting of Division By-Laws Committee, Room 1840-42.

3:30 P.M.—Meeting of Local Section Advisory Committee, Room 1840-42.

7:30 P.M.—Meeting of Board of Directors, Parlor F, Mezzanine.

Thursday, October 13, 1949

8:00 A.M.—Breakfast meeting of the Publication Committee and Editorial Staff.

TECHNICAL SESSION SCHEDULE

	Thursday		Friday		Saturday	
Meetings	**A.M.**	**P.M.**	**A.M.**	**P.M.**	**A.M.**	**P.M.**
Corrosion	A	A		B		
Electrodeposition				A	A	
Electro-Organic	B	B	A			

A - Century Room
B - Press Gallery

MEETINGS OF A.S.T.M. COMMITTEE B-8 ON ELECTRODEPOSITED METALLIC COATINGS

Held in conjunction with Convention of The Electrochemical Society

Wednesday, October 12, 1949

1:30 P.M.—Meetings of Working Sections (Closed)

3:00—Advisory Committee (Closed)

Thursday, October 13, 1949

Room 1860

9:00 A.M.—Subcommittee II on Performance Tests (Visitors Welcome)

10:30—Subcommittee III on Conformance Tests (Visitors Welcome)

1:30 P.M.—Subcommittee V on Supplementary Protective Finishes for Metallic Coatings (Visitors Welcome)

3:00—Subcommittee I on Specifications, Papers and Definitions (Visitors Welcome)

Friday, October 14, 1949

Room 1860

9:00 A.M.—Committee B-8 on Electrodeposited Metallic Coatings (Visitors Welcome)

REPRINTS

Copies of the July, August, September, and October issues of the JOURNAL OF THE ELECTROCHEMICAL SOCIETY containing papers presented before the Convention will be available at the Registration desk. The price of single copies of the JOURNAL is 75 cents to members and $1.00 to nonmembers.

DISCUSSION

There will be no recordings made of oral discussions. Those contributing to the discussion of a paper and desiring their remarks published will be supplied with a printed form on which any questions may be written. These forms must be given to the Secretary-Treasurer of the Division at the end of the session. The questions will then be referred to the authors for reply.

A discussion section will be published in Volume 96 of the TRANSACTIONS. With the discontinuance in 1950 of the Transactions, discussion will appear semi-annually in the JOURNAL.

TECHNICAL PROGRAM

THURSDAY, OCTOBER 13, 1949

SECTION A—CENTURY ROOM

(Note that Section B—Symposium on Electro-Organic Chemistry will begin at 9:15 A.M. in the Press Gallery and will be held simultaneously with Section A. Several other sessions will also be held in parallel.)

Symposium on Corrosion *
Inhibition and Passivation
with Dr. Mars G. Fontana presiding

9:00 A.M.—Formal opening of the 96th Convention with Introduction by General Chairman Clifford A. Hampel and Response by President Ferguson.

9:15 A.M.—Norman Hackerman and E. L. Cook, University of Texas, Austin, Texas. "Effect of Adsorbed Polar Organic Compounds on Activity of Steel in Acid Solutions"

The reactivity of steel in aqueous hydrochloric acid has been determined as a function of both extent and type of adsorption of a variety of polar organic compounds from benzene solution. It was

* The final ten minutes of time allotted for papers in this session will be devoted to discussion.

found that the inhibiting effectiveness of the n-alkyl compound decreased in the order acid > amine > alcohol ≥ esters both for undesorbable and total adsorbed additive. Maximum inhibition occurred with dual adsorption wherein each component adsorbed most strongly on different portions of the surface.

9:45—H. H. Uhlig and Harry C. Gatos, Massachusetts Institute of Technology, Cambridge, Mass. "Sodium Metaphosphate as Corrosion Inhibitor for Iron; Effect of Oxygen and Chloride"

A satisfactory mechanism for corrosion inhibition by metaphosphates is still not available. Since metaphosphates form soluble iron complexes and produce a more active electrode potiential for iron, it seems unlikely that oxide or phosphate films come into play. Data are presented showing the effect of dissolved oxygen on the corrosion rate of iron in the presence of 60 ppm of metaphosphate. These data prove that dissolved oxygen is beneficial to inhibition, and, hence, the mechanism of metaphosphate behavior probably derives, in part, from the presence of oxygen. Data were also obtained for various sodium chloride concentrations containing 60 ppm inhibitor. Above 50 ppm NaCl, the corrosion rate increases rapidly. This is in line with the expected action of chlorides in breaking down passivity.

10:15—R. B. Mears, Carnegie-Illinois Steel Corporation, Pittsburgh, Pa., and R. H. Brown, Aluminum Research Laboratories, New Kensington, Pa. "A Unified Mechanism of Passivity and Inhibition II"

It is shown that the inhibiting action of sodium chromate on localized corrosion of aluminum exposed to a sodium chloride solution is mainly the result of polarization of the local anodes. Polarization curves obtained by the use of currents from an external source are of value in studying the mechanism of inhibitor action only if information on local cell behavior can be derived from them. Two indirect methods of estimating the anodic and cathodic polarization curves of the local cells are described. The practical application of these methods is limited by the assumption that the areas of the local anodes and cathodes are not altered by the application of external current. The relationship of "reversible" potentials of metals as calculated from free energy data and as measured in aqueous solutions is discussed. It is indicated that polarization plays an important role in the measurment of potentials commonly accepted as reversible.

10:45—Norman Hackerman and J. D. Sudbury, University of Texas, Austin, Texas. "The Effect of Amines on the Electrode Potential of Mild Steel in Tap Water and Acid Solutions"

The steady state potential of SAE 1020 steel in aqueous solutions containing amines was found to be a function of the nature and concentration of the amine. It was shown that both anodic and cathodic areas were affected by the amines. It is postulated that the effects are due to adsorption of the polar compounds and to the heterogenity of the surface and an attempt is made to fit this information into a generalized theory of corrosion inhibition.

Thursday—Corrosion

11:15—Morris Cohen, Rowena Pyke, and Paul Marier, National Research Council, Ottawa, Canada. "The Effect of Oxygen on Inhibition of Corrosion by Nitrite"

It was found that at any given temperature an increase in concentration of oxygen decreased the amount of nitrite required for inhibition. At high temperatures and low oxygen concentrations, the rate of corrosion was appreciable while the rate of nitrite breakdown was low. These results further substantiate the mechanism for inhibition by nitrite proposed previously. A Rocker Immersion apparatus modified to give controlled atmosphere is also described.

11:45—Recess for lunch.

2:00 P.M.—Thomas P. May, International Nickel Co., Inc., New York, N. Y., and Robert L. Burwell, Jr., Northwestern University, Evanston, Ill. "Measurement of the Surface Roughness of Metals"

The importance of surface roughness in corrosion processes and in the adhesion of paints to metal surfaces is discussed. A description is given of the method of gas adsorption at low temperature and pressure for determining small surface areas. In some instances, the method permits detection of pores in a surface and an estimate of the number of pores per unit area and of their average size. Small specimens are utilized and the method of handling during application of the method reduces changes in the surface to a minimum. A number of results obtained by the method are reviewed. More extensive use of the method should provide useful information concerning electrodeposited coatings and conversion coatings on metals.

2:30—W. D. Robertson and H. H. Uhlig, Massachusetts Institute of Technology, Cambridge, Mass. "Chemical Properties of the Intermetallic Compounds Mg_2Sn and Mg_2Pb"

Rates of oxidation were measured at 20 C as a function of humidity, and as a function of temperature in the range of 350 to 550 C. Reaction rates and reaction mechanisms in inorganic media were investigated together with qualitative observations on reactions with organic compounds. Irreversible solution potentials were measured in inorganic electrolytes as a function of time. A new form of crystallographic disintegration of Mg_2Sn in distilled water was observed.

3:00—M. T. Simnad, Carnegie Institute of Technology, Pittsburgh, Pa. "The Electrochemistry of Stressed Metals"

A critical survey is made of work on the chemical and physical manifestations of internal stresses, and their bearing on the electrochemistry of metals is discussed. The influence of stress upon electrode potential and solution rate, the effect of surface condition on corrosion, the phenomena of stress-corrosion cracking and corrosion-fatigue, and the presence of stress in electrodeposits, are reviewed.

3:30—H. D. Holler, National Bureau of Standards, Washington, D. C. "Studies on Galvanic Couples, Part I—Measurement of Electromo-

tive Force and Internal Resistance of Cells During Current Flow. Part II—Some Potential Current Relations in Galvanic Corrosion"

Part I. A bridge-potentiometer technique was developed for measuring the effective emf of an electrolytic cell and its resistance during flow of current including a circuit in which a recording potentiometer may be used to obtain emf-time curves without any error due to I R potential drops in the measuring circuit. By the use of a reference half-cell, the polarization characteristics of individual electrodes may be determined and the relations of possible resistances in galvanic couples to observed potentials may be derived. Possible application to cathodic protection is discussed.

Part II. The potential current relations of several galvanic couples corroding in an air-deficient environment and the effect of external current impressed upon them are demonstrated. It was found that the above relations may be correlated with the corrosion current and the protective external current required to stop corrosion. Under the conditions specified, these currents may be evaluated from the polarization curves for the couples studied.

4:10—Walter Beck, Lehigh University, Bethlehem, Pa. "Application of an Electrolytic Probe Technique to the Measurement of Corrosion Currents Underground"

A probe consisting of an electrode of the same material as a buried structure is fastened to, but insulated from, the pipe surface and connected to the buried structure through a sensitive ammeter. The polarization characteristics of electrodes of steel and lead were followed by measurements in tap water or moist soil. Stray current measurements were performed on buried pipe and cable lines using electrolytic probes as measuring electrodes. The currents emitted or picked up by the auxiliary electrodes were followed by a special oscillographic procedure.

4:40—Annual Business Meeting of Corrosion Division.

(Note—Symposium on Corrosion continues Friday, October 14, at 2:00 P.M. in the Press Gallery.)

SECTION B—PRESS GALLERY

Symposium on Electro-Organic Chemistry with Dr. Clyde A. Crowley presiding

9:15 A.M.—B. B. Dey, T. R. Govindachari, and S. C. Rajopalan, Presidency College, Madras, India. "Electroreduction of Aromatic Nitrocompounds. Part I. Alkaline Media"; B. B. Dey, R. K. Maller, and B. R. Pai. "Part II. Acid Media"

The two papers cover work already published. Hydrazobenzenes are produced in excellent yield using an alkaline emulsion of nitro-compound, an iron cathode, and lead monoxide as catalyst. A cell using 10 kg nitrobenzene and 450 amperes gave an overall material yield of 90 per cent. Reduction in acid emulsion gave para-aminophenol in high yield.

Contrary to the literature, 20 to 30 per cent sulfuric acid is adequate if monel or copper cathodes are used together with a mercury catalyst.

9:30—Theodore C. Schwan, Valparaiso University, Valparaiso, Indiana, Eugene Dineen, and Christopher L. Wilson, Ohio State University, Columbus, Ohio. "Electrolytic Reduction of Organic Compounds. Part V. Cathodic Initiation of Vinyl Polymerization in Acrylic Acid, Methyl Acrylate, and Methacrylate. Carbonyl Reduction in Crotonic Acid" 12C

The behavior of acrylic acid and its methyl ester, methyl methacrylate, alpha chlorocrylic acid, and crotonic acid in a sulfuric acid electrolyte at a mercury cathode is described. Dimeric products are not obtained. Reduction to dihydro-compounds is slow and difficult but, with acrylic and methacrylic derivatives, polymerization is rapid. At both lead and mercury cathodes, crotonic acid is reduced to butyric acid together with butyl alcohol and crotyl alcohol.

9:50—G. W. Thiessen, Donald Hill, and George Lauterbach, Monmouth College, Monmouth, Ill. "Attempts to Prepare sym-Diphenylethylene Glycol from Mandelic Acid" 13C

Early attempts to convert the mandelate ion to $C_6H_5 \cdot CHOH \cdot CHOH \cdot C_6H_5$ by aqueous electrolysis produced mainly benzaldehyde. Similar results were obtained by electrolysis of mandelate in pyridine, in this study. Gas analysis confirmed the large production of unsaturated material, by the carbon dioxide-hydrogen ratio. Small amounts of what appeared to be the desired glycol were isolated as the benzoate. Pyridine, therefore, does not appreciably improve this preparation.

10:10—Sherlock Swann, Jr., University of Illinois, Urbana, Ill., K. H. Wanderer, H. J. Schaffer, Monsanto Chemical Company, St. Louis, Mo., and W. A. Streaker, General Electric Company, Mechanicville, N. Y. "The Electrolytic Reduction of Maleic Acid to Succinic Acid in Acid Solution" 14C

The electrolytic reduction of maleic acid in solutions of sulfuric acid has been studied at cathodes of copper, zinc, cadmium, mercury, aluminum, tin, lead, bismuth, iron, cobalt, and nickel. The best yield of succinic acid was obtained at a mercury cathode. The activities of copper and nickel cathodes were affected by etching. Changes in the physical structures of other cathodes were transient in effect with the possible exception of those of zinc.

10:30—P. H. Bame and N. F. Murphy, Virginia Polytechnic Institute, Blacksburg, Va. "The Electrochemical Hydrogenolysis of Glucose" 15C

An investigation of the electroreduction of glucose, in 5 and 10 per cent sodium hydroxide-sodium sulfate solution at 38 to 43 C at lead cathode, produced one fraction which was soluble in acetone, water, and alcohol, insoluble in ether; and another fraction insoluble in acetone, but soluble in water. This fraction is apparently formed from the previous fraction by polymerization and is probably a polyhydric methyl ketone or aldehyde.

Thursday—Electro-Organic

10:50—M. T. Sanders and R. A. Hales, Atlas Powder Company, Wilmington, Del. "Performance of Electrolytic Cells in the Reduction of Glucose"

The cell and associated equipment are described. Data are presented to show the effects of varying current density, initial sugar concentration, ratio of cathode area to volume of catholyte, alkalinity, and temperature. The limiting rate of reduction is proportional to the concentration of sugar in the catholyte. Magnesium behaves as a cathode poison.

11:10—Colin G. Fink and Harold Arthur Golle, Columbia University, New York, N. Y. "Electrodialysis of Reduced Keratin Solutions"

Reduced keratin solutions were electrodialyzed so as to remove sulfur containing ions, primarily thiosulfate and sulfide ions, which produce objectionable free sulfur in the keratin when the reduced keratin solutions are coagulated by the addition of acid. The degree of purification was found to be proportional to the quantity of electricity passed through the cell and independent of the temperature. At a fixed current density, decrease in yield was found to be proportional to time of electrodialysis. Nickel anodes and graphite cathodes are suitable electrodes.

11:30—Recess for lunch.

Symposium on
Electro-Organic Chemistry (cont'd)
with Dr. C. L. Wilson presiding

2:00 P.M.—James B. Redd, The Citrus School, Florida Southern College, Lakeland, Fla. and J. Erskine Hawkins, University of Florida, Gainesville, Fla. "Reactions of β-Pinene. III. Electrolytic Oxidation"

It is shown that some of the compounds formerly reported to be electrolytic oxidation products of turpentine are not oxidation products but are products of isomerization and hydration. These latter reactions are due to the influence of the emulsifying agents used in the electrolytic process. Other reported products appear to have been present in the original substances used. The effect of electrolytic oxidation on α- and β-pinenes and on cyclohexene under the stated conditions is presented.

2:20—Bernard O. Heston and Sam R. Faris, University of Oklahoma, Norman, Okla. "Electrochemical Oxidation of Ethanol to Acetaldehyde at Platinum Anodes"

After exploratory work with microelectrodes, the oxidation of ethanol at controlled anode potential was selected for further study. Results for smooth and platinized electrodes are presented to show that quantitative conversion of the alcohol to acetaldehyde is accomplished at potentials too negative for oxygen evolution. A mechanism is proposed on the basis of these findings.

2:40—George L. Drury, S.J., and André J. deBéthune, Boston College, Mass. "The Oxidation of Ethyl Alcohol and of Chloride Ion at a Platinum Microanode"

The oxidation of ethanol was investigated at a platinum microanode in hydrochloric and sulfuric acids. In solutions less than 0.01*M*, no current step was observed before the appearance of the chlorine or oxygen wave. In solutions 1*M* ethanol or more, a marked rise in current was observed, almost linear in the anode potential, and not markedly dependent on concentration. The height of the chlorine wave was bimolecular in chloride ion.

3:00—R. MacLeod Elofson, Robert L. Edsberg, and Patricia A. Mecherly, General Aniline & Film Corporation, Easton, Pa. "Application of the Dropping Mercury Electrode to Diazo Chemistry"

Diazotized aromatic amines are reduced irreversibly in two or more steps at the dropping mercury electrode. Below pH 8-9, the waves are suitable for quantitative estimation of the diazotized amines. One of the waves occurs at potentials well below the waves of other reducible materials ordinarily present. Therefore, it is possible to follow diazotization rates, coupling rates, etc., by using the dropping mercury electrode for continuous recording of diazo concentrations.

3:20—Stanley Wawzonek and J. H. Fossum, State University of Iowa, Iowa City, Iowa. "The Behavior of γ-Keto and Aldehydo-Acid Derivatives at the Dropping Mercury Electrode. IV. Phthaldehydic Acid Derivatives"

The polarographic method has been shown to be a suitable means of assigning structures to the derivatives of β-[p-bromobenzoyl] crotonic and 2-benzoylbenzoic acid derivatives with the exception of the anhydrides of 2-benzoylbenzoic acid. Additional data obtained from the study of phthaldehydic acid derivatives, the structures of which are well known, in unbuffered and buffered media indicate that 2-benzoylbenzoic anhydride and di-2-benzoylbenzoyl sulfide have normal structures while the mixed anhydride from acetic acid and benzoylbenzoic acid has a cyclic structure.

FRIDAY, OCTOBER 14, 1949

SECTION A—CENTURY ROOM

Symposium on

Electro-Organic Chemistry (cont'd)

with Dr. H. R. Neumark presiding

9:00 A.M.—Manuel Shaw and A. Edward Remick, Wayne University, Detroit, Mich. "Studies on Alternating Current Electrolysis. I. The Nature of Polarization Capacity and Polarization Resistance"

The alternating current characteristics of electrolytic cells were studied. The interrelationships between the following variables were investigated: polarization capacitance, polarization resistance, frequency, redox ratio, current density, and concentration of electrolyte. These interrelationships were compared for actively reversible and sluggishly reversible redox systems above and below

the capacitive elevation point. A theory was proposed which qualitatively explains the observed relationships. Studies were also made which indicated that H_3O+ is strongly adsorbed on platinum.

9:20—Jacob Silverman and A. Edward Remick, Wayne University, Detroit, Mich. "Studies on Alternating Current Electrolysis. II. Oscillographic Studies"

Oscillographic studies were made of the alternating current characteristics of electrolytic cells containing reversible redox systems and/or aqueous sulfuric acid. As the current density was increased, the value of the cell potential at zero current for sulfuric acid was found to approach a maximum which was interpreted as the dynamic decomposition potential of water. Half-cell oscillograms of all systems were interpreted in detail in terms of two competing polarizations: physical and chemical.

9:40—Philip J. Elving, The Pennsylvania State College, State College, Pa. "The Polarographic Behavior of Organic Compounds"

Recent developments in the theory and practice of polarographic measurements are discussed in reference to the interpretation of the polarographic behavior of organic substances. The factors discussed include: (1) current-controlling processes with special reference to rate processes; (2) polarographic reactivity; (3) reversibility of polarographic reactions; and (4) environment conditions.

10:00—K. G. Stone, Michigan State College, East Lansing, Mich. "Complex Species in Organic Polarography"

A comparison of potentiometric and polarographic measurements shows that the effect of pH may not be the same if the reduced species is stabilized by resonance. Buffer constituents are important in polarography if a stable species is formed between the buffer anion and one of the redox components. The direct determination of the diffusion coefficient is desirable.

10:20—G. Sartori and A. Liberti, Instito Chimico, Universita Di Roma, Rome, Italy. "Polarographic Investigation of Mercaptobenzothiazole"

The cathodic and anodic behavior of mercaptobenzothiazole at the dropping mercury electrode has been investigated. It has been found that the anodic electrode reaction does not correspond to an oxidation to mercaptodisulfide, but to the formation of a mercurous compound. An equation has been derived to interpret the experimental results: from the dependence of the half-wave potential on the pH, it has been possible to calculate the dissociation constant of mercaptobenzothiazole; this value is in agreement with the one obtained potentiometrically. The catalytic nature of the cathodic waves has been demonstrated. The height of this wave, i.e., the current due to the catalytic evolution of hydrogen, is proportional to the hydrogen ion concentration of the buffer and it depends on the concentration of the catalyst through a relationship given by the Langmuir's isotherm.

10:40—Melvin Fields and Elkan R. Blout, Tracerlab, Inc., Boston, Mass. "Polarographic Studies on Aliphatic Polyene Aldehydes"

The polarographic behavior of aliphatic polyene aldehydes has been examined in buffered 50 per cent dioxane solution over the pH range 1 to 11. The variations in half-wave potentials and the $i_d/Cm^{2/3}t^{1/6}$ ratios have been examined as functions of pH and the number of double bonds in the molecule.

10:55—Melvin Fields, Claude Valle, Jr., and Marshall Kane, Tracerlab, Inc., Boston, Mass. "Polarographic Studies of Some Hindered and Unhindered Aromatic Nitro Compounds"

The polarographic characteristics of nitrobenzene, *o*-,*m*-, and *p*-nitrotoluene, 2-nitro-1, 4-dimethylbenzene, 3-nitro-1, 2-dimethylbenzene, nitromesitylene, and nitrodurene have been examined in buffered 80 per cent aqueous dioxane solutions at pH 1.0, 7.2, and 12. The behavior of nitromesitylene and nitrodurene is distinctly different from that of the aromatic nitro compounds examined in which steric inhibition of resonance does not exist.

11:10—R. A. Pasternak, University College, London, England. "The Mechanism of Electrochemical Reduction of Aryl Ketones and α, β-unsaturated Ketones"

The mechanism of the electrochemical reduction of aryl ketones and α, β-unsaturated ketones is discussed. Experimental results obtained by the polarographic method and by preparative electrochemical reduction at controlled potentials are reported. It may be concluded from them that the reduction of both the carbonyl group in aryl ketones and the ethylene bond in unsaturated ketones most probably proceeds in two univalent steps with a radical as intermediate. A reaction mechanism is tentatively proposed.

11:30—Recess for lunch.

SECTION B—PRESS GALLERY

Symposium on Corrosion (cont'd)* with Dr. Mars G. Fontana presiding

2:00 P.M.—L. W. Smith, Cornell Aeronautical Laboratory, Inc., Buffalo, N. Y., and V. J. Pingel, Fansteel Metallurgical Corporation, North Chicago, Ill. "A Micro Solution Potential Measuring Technique"

A technique of measuring the solution potential of a metal or alloy on a micro scale has been developed. This consists of electrically insulating with a transparent plastic film the polished and etched surface of the metal specimen mounted in lucite or bakelite, puncturing the film at the desired location with aid of a specially adapted Tukon Hardness Tester, and then determining the solution potential at the point of puncture. In this manner it is possible to examine an alloy of normal grain size with aid of the Tukon microscope (566X) and obtain the solution potential of any desired part of the micro-structure. Results with a number of aluminum-base alloys are reported.

* The final ten minutes of time allotted for each paper in this session will be devoted to discussion.

Friday—Electrodeposition

2:30—Michael A. Streicher, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del. "The Dissolution of Aluminum in Sodium Hydroxide Solutions II" 32C

The effect of impurities, concentration of sodium hydroxide, temperature, agitation, and the effect of an external current on the dissolution of a series of aluminum specimens ranging in composition from 99.2 per cent to 99.998 per cent Al was investigated. In addition, an aluminum alloy containing 2.5 per cent Mg and 0.5 per cent Cr was studied. The electrochemical basis of this process is discussed.

3:00—J. V. Petrocelli, Patent Button Company, Waterbury, Conn. "The Electrochemical Behavior of Aluminum" 33C

A detailed study of the reactivity of pure aluminum with cerium (IV) sulfate in sulfuric acid is presented. Electrode potentials, weight loss data, and polarization curves are given, and it is shown that the reaction may be interpreted from an electrochemical point of view. The theory of the "mixed potential" is suggested as a more generalized concept than the local cell idea for the interpretation of the dissolution process.

3:30—M. E. Straumanis and N. Brakšs, University of Missouri, School of Mines and Metallurgy, Rolla, Mo. "The Rate of Solution of High Purity Aluminum in Various Bases" 34C

Dissolution experiments of high purity Al (99.998%) in KOH, $Ba(OH)_2$, $Sr(OH)_2$, $Ca(OH)_2$, $Mg(OH)_2$, and NH_4OH solutions of different concentrations were carried out. For monovalent bases the velocity of dissolution increases with the cube root and for divalent bases with the square root of the concentration. At higher concentrations, the rate is simply proportional to the concentration. The velocity-concentration curve for NH_4OH solutions follows neither of these relationships.

4:00—M. E. Straumanis and N. Brakšs, University of Missouri, School of Mines and Metallurgy, Rolla, Mo. "The Effect of Minor Alloying Elements on the Rate of Dissolution of Aluminum in Bases" 35C

The dissolution rate of Al in the bases (0.5*N* NaOH, $Ba(OH)_2$ and NH_4OH) is increased by addition of minor alloying elements, especially by those of low hydrogen overvoltage to Al, e.g., Pt, Fe, and Cu. The rate of solution is proportional to the log of the concentration of the minor element in the Al. The activity of local currents ceases at 0.000016 — 0.000004 per cent in Al for Fe and Cu. The effect of alloying elements with high hydrogen overvoltage is entirely different.

SECTION A—CENTURY ROOM

Symposium on Electrodeposition
with Dr. Ralph A. Schaefer presiding

2:00 P.M.—M. L. Holt and H. J. Seim, University of Wisconsin, Madison, Wis. "Electrodeposition of Molybdenum Alloys" 36C

Friday—Electrodeposition

A new aqueous bath for the electrodeposition of alloys of molybdenum with cobalt, iron, and nickel is reported. The plating bath contains the sulfate of the codeposited metal, citric acid, sodium molybdate, and ammonium hydroxide. Experimental results obtained by using the Hull cell for qualitative information and regular plating procedures for quantitative data show the effect of bath pH, concentration of sodium molybdate, and cathode current density on the performance of the plating baths.

2:20—Sister Mary Joecile Ksycki, Webster College, St. Louis, Mo., and L. F. Yntema, Fansteel Metallurgical Corp., Chicago, Ill. "The Electrodeposition of Molybdenum from Aqueous Solutions"

Metallic molybdenum can be electrodeposited from aqueous solutions of molybdic acid containing high concentrations of salts. Formates, acetates, propionates, fluorides, and phosphates of sodium, potassium, and ammonium have been used. The optimum pH range as measured with a glass electrode is 5.5 to 6.8; temperature: 30 to 55 C. The current density may be varied from 0.06 to 3.3 amp/cm². Deposits were obtained on copper, nickel, and iron cathodes; platinum or carbon may be used as anode.

2:40—A. L. Ferguson and N. W. Hovey, University of Michigan, Ann Arbor, Mich. "The Electrodeposition of Copper-Lead Alloys"

A number of solutions from which copper-lead alloys might be deposited were investigated. The most promising of these, a cyanide-tartrate solution, was studied in detail. Using a rotating cathode set-up, the effects on alloy composition, single metal potentials, and alloy potentials were determined for all of the possible variables. The alloys were hard and brittle except those containing a high percentage of lead. Reproducibility was satisfactory over a short period of time but the composition of the deposits changed in the direction of a higher lead content as the plating solution aged.

3:10—A. L. Ferguson, N. W. Hovey, and A. Krohn, University of Toledo, Toledo, Ohio. "Aging Effects in Copper-Lead Alloy Plating Solutions of the Cyanide-Tartrate Type"

Effects of aging the solution during a 50-day period were studied by measurements of single metal potentials, static and dynamic alloy potentials, oxidation-reduction potentials, alloy composition, and absorption spectra of the plating solution. Similar measurements made on a portion of the solution stored under nitrogen established atmospheric oxidation as the cause of aging.

3:30—D. W. Hopkins, University College, Swansea, Wales, Great Britain. "A Reaction Between Solids; the Formation of Zinc Ferrite from Zinc Oxide and Ferric Oxide"

Zinc metaferrite formation, from a stoichiometric mixture of the pure oxides, has been investigated between 600 and 1150 C. The rate increases with temperature and is dependent on whether the ferric oxide is prepared at above or below 678 C. High temperature ferric oxide is relatively inactive. The reaction is controlled by diffusion of the ferric oxide through the metaferrite layer. Activation energies have been calculated.

Saturday—Electrodeposition

3:50—Howard T. Francis and William H. Colner, Armour Research Foundation of Illinois, Institute of Technology, Chicago, Ill. "Cyclic Phenomena Observed in Electro-polishing of Silver" 41C

When silver is electropolished, a cycling of the current is noted. The frequency of this effect has been found to be dependent on the stability of the d-c source. It has been noted that best polishing is obtained at the highest frequency. Oscillograms have been prepared, showing the wave form of the a-c component of the current.

4:10—R. Scott Modjeska and S. P. Gary, Jr., Scientific Control Laboratories, Chicago, Ill. "The Electrodeposition of Bismuth From Aqueous Solution" 42C

A study into the methods of electrodepositing bismuth from aqueous solution for industrial application was made. Baths of previous investigators were tried without much success. The perchlorate baths gave most nearly satisfactory results. Addition agents were found beneficial in obtaining close grained metallic-white deposits. All metallic-white deposits had fair adhesion. Dark, sponge deposits had no adhesion. Difficulty is not in depositing the metal but in obtaining continuous adherent-dense deposits. The requisite 0.002 in. deposit was not obtained.

SATURDAY, OCTOBER 15, 1949

SECTION A—CENTURY ROOM

Symposium on Electrodeposition (cont'd)

with Dr. Ralph A. Schaefer presiding

9:00 A.M.—Donald G. Rogers and Arthur A. Burr, Rensselaer Polytechnic Institute, Troy, N. Y. "Theory of Rate Processes as a Means of Studying Plating Reactions" 43C

The application of modern theory of rate processes to plating cells has been discussed. Suggestions based on equations adapted from the literature have been made for a method of study of plating cells where current efficiency is less than 100 per cent and a procedure outlined involving current-voltage curves. Data collected for the plating of chromium from chromic acid show the applicability of the equations and indicate the possibility of this method of study for irreversible cells. The effect of sulfate ratio on the plating process has been studied by this method and data indicate that beneficial results from the sulfate ion result from a retardation of the hydrogen deposition rather than catalysis of the plating reaction.

9:20—Donald G. Rogers and Arthur A. Burr, Rensselaer Polytechnic Institute, Troy, N. Y. "Electrodeposition of Chromium-Tungsten Alloy Plates" 44C

Thin bright plates of chromium-tungsten alloy containing up to about 40 per cent tungsten have been deposited from chromic acid solutions reduced with an organic salt to a trivalent chromium

content of 30 to 50 per cent and made alkaline to a pH of approximately 8. These plates are deposited only at high current densities and at very low current efficiencies, and the maximum plate thickness attained is limited. It is possible to obtain deposits of nearly 0.0001 inch in thickness, however, and these plates have remarkable resistance to attack by corrosive media. Preparation of the solutions and the effect of various factors on the deposit composition and characteristics are described.

9:40—A. Brenner and Fielding Ogburn, National Bureau of Standards, Washington, D. C. "Experiments in Chromium Electrodeposition with Radioactive Chromium"

There have been conflicting ideas regarding the mechanism of the electrodeposition of chromium from a chromic acid bath. Experiments employing a radioactive tracer containing the isotope Cr^{51} have shown that chromium is deposited directly from the hexavalent state and not through an intermediate step involving trivalent chromium.

10:00—Cloyd A. Snavely and Charles L. Faust, Battelle Memorial Institute, Columbus, Ohio. "Studies on the Structure of Hard Chromium Plate"

The structural changes which take place during the annealing of chromium plate are illustrated by a series of photomicrographs. It is shown that recrystallization can be effected between 300 C (572 F) and 500 C (932 F). Loss of hardness is concurrent with recrystallization. A slight loss of hardness at lower annealing temperatures is ascribed to recovery from internal stress. The basis metal is shown to have an effect on the rate at which a growing electrodeposit assumes the normal preferred orientation. The results of hydrogen-extraction tests are given for temperatures up to 650 C (1202 F). X-ray and electron-diffraction studies are presented to show that heating to above the temperature range at which the plate softens does not destroy the normal (111) preferred orientation.

10:20—Samuel Heiman, Philadelphia Rust-Proof Company, Philadelphia, Pa. "Deposition of Metals on Aluminum by Immersion from Solutions Containing Fluorides"

A new process is described for depositing zinc, cadmium, and tin by chemical displacement upon aluminum from solutions containing the metal sulfate and either hydrofluoric acid or fluoride ion. The zinc deposits may be used as a base for plating other metals. The effectiveness of the method results from the high solubility of the aluminum oxide film in solutions containing fluoride ion in acid environment as shown by published solubility data and by potential measurements.

10:40—F. Keller and Walter G. Zelley, Aluminum Company of America, New Kensington, Pa. "Conditioning Aluminum Alloys for Electroplating"

Successful use of the zinc immersion process for plating aluminum alloys is dependent on the effectiveness of the surface conditioning treatments used prior to the immersion zinc dip. Various conditioning treatments are described for removing constituents that may cause difficulty during plating and for obtaining a uniform and active surface for deposition of the zinc layer. The manner

in which the conditioning treatments and variations in the zinc immersion layer may affect the performance of plated aluminum alloys is described.

11:00—Fredrick A. Lowenheim, Metal & Thermit Corporation, Rahway, N. J. "A High Efficiency Anode for Alkaline Tin Plating"

The effect of twenty-six alloying elements, in amounts up to about 1 per cent upon the anode efficiency of tin in alkaline stannate solutions was studied. They fall into three categories, according to whether they raise or lower the anode efficiency or have negligible effect. The result of greatest practical interest is the beneficial effect of small amounts of aluminum, and it is proposed to incorporate this metal into tin anodes for improved plating efficiency.

11:20—H. F. Beeghly, Jones & Laughlin Steel Corporation, Pittsburgh, Pa. "An X-Ray Method for Determining Tin Coating Thickness on Steel"

A nondestructive method for measuring the thickness of tin on steel is based upon absorption by the coating of secondary x-rays excited in the base metal by means of an x-ray beam. The accuracy of this method is comparable to that of conventional methods. The principle used for measuring tin on steel is applicable to other coatings and is being adapted to the continuous indication and control of tin coating weights on the electrotinning line.

SPRING MEETING

at the

STATLER HOTEL

Cleveland, Ohio

April 19, 20, 21, and 22, 1950

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SESSIONS ON

Electrothermics
Instrumentation
Luminescence
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